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Report on the United Nations/China/European Space Agency Conference on Space Applications in Promoting Sustainable Agriculture

(Beijing, 14-17 September 1999)

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I. Introduction

A. Background and objectives

1. In its resolution 37/90 of 10 December 1982, the General Assembly decided that, in accordance with the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space,[1] the United Nations Programme on Space Applications should be directed towards, among other things, stimulating the growth of indigenous nuclei and an autonomous technological base in developing countries. The Committee on the Peaceful Uses of Outer Space, at its forty-first session, held in June 1998, endorsed the programme of training courses, workshops, conferences and symposia proposed for 1999 by the Expert on Space Applications. In its resolution 53/45 of 3 December 1998, the Assembly endorsed the United Nations Programme on Space Applications for 1999.

2. The United Nations/China/European Space Agency Conference on Space Applications in Promoting Sustainable Agriculture was held in Beijing from 14 to 17 September 1999. It was organized for the benefit of Member States in Asia and the Pacific. The Conference focused on operational applications as well as on current trends in the use of various space technologies for ensuring sustainable development of agriculture, including forestry, fisheries and rangeland farming. The Conference was hosted by the Government of China, through the Ministry of Science and Technology and the Ministry of Agriculture, and was co-sponsored by the European Space Agency (ESA).

3. The present report describes the organization of the Conference, its programme, discussions held by the participants and proposed follow-up action. The report has been prepared for consideration by the Committee on the Peaceful Uses of Outer Space at its forty-third session and by the Scientific and Technical Subcommittee at its thirty-seventh session, in 2000.

B. Organization

4. In his notes verbales of 8 April and 8 June 1999, the Secretary-General invited Member States of the Asia-Pacific region to nominate representatives of government agencies as well as of the private sector to attend the Conference. The local offices of the United Nations Development Programme (UNDP) in each of the Member States invited were also informed about the Conference. Nominations were subsequently evaluated by the Office for Outer Space Affairs of the Secretariat.

5. All persons nominated by government agencies or private institutions in Asia and the Pacific were accepted as participants. The 76 participants at the Conference included 47 representatives from several organizations within China. Participants from the region were nationals of the following 14 countries: Australia, Bangladesh, Cambodia, China, India, Indonesia, Malaysia, Mongolia, Myanmar, Pakistan, Philippines, Republic of Korea, Thailand and Viet Nam. Funds to cover the cost of air travel of 13 participants from developing countries were provided from the fellowship budget of the United Nations Programme on Space Applications and by ESA. The Government of China provided room and board for 14 participants from developing countries.

6. Invited speakers came from several institutions or private industry: the Office for Outer Space Affairs, UNDP, Economic and Social Commission for Asia and the Pacific (ESCAP), the World Meteorological Organization, ESA, the International Society for Photogrammetry and Remote Sensing, the Canada Centre for Remote Sensing (CCRS), Geophysical and Environmental Research Corporation (United States of America), the Surrey Space Centre (United Kingdom of Great Britain and Northern Ireland) and Spot Image (France).

II. Programme of the Conference

7. The programme of the Conference (see annex) was prepared jointly by the Office for Outer Space Affairs, the Government of China and ESA and was designed to highlight the advances being made in space technologies that were of relevance to agricultural development as well as to focus on ways in which Member States could benefit from each other's experiences. Formal technical presentations during the first of the three sessions focused on the role of remote sensing in achieving national food security, mapping from space, agricultural applications of small satellites, as well as recent trends in remote sensing and meteorological and global navigation satellite systems. A special presentation on the history and status of technical cooperation between ESA and China was made during the first session. Presentations made during the second session related to land-use planning, the use of remote sensing in supporting crop management, precision farming, the

relative expansion of urban and rural areas, forestry and rangeland monitoring. Topics presented during the third session dealt with information systems supporting research and development activities in agriculture, education and training in agriculture, as well as agricultural disasters, including those related to forest fires.

III. Summary of presentations[2]

A. Relevant space technologies

8. Remote sensing was regarded as a critical tool for achieving national self-sufficiency in food and food security in many developing countries in Asia and the Pacific in that there were no other cost-effective means of providing relevant information with the regularity and objectivity needed for agricultural planning and operational decision-making. Remote sensing data useful for agricultural purposes were currently being collected by several different satellite systems. Data were available from a variety of sensors of differing spatial, spectral and temporal resolutions.[3] Of special interest was the fact that several commercial ventures were offering or planning to offer in the near future remote sensing imagery of high spatial resolution (less than 1 metre). Remote sensing data were increasingly being integrated in geographic information systems (GIS) with other geo-spatial data, including data from global navigation satellite systems, in order to assist in decision-making pertaining to agriculture within the region. Such efforts were growing despite some problems, such as lack of comprehensive digital data sets and standard data formats, that hindered implementation of operational systems. Current applications of remote sensing in agriculture included land resource investigation (i.e. determining the suitability of land for agricultural purposes), estimates of crop area, classification of crop type, monitoring of crop condition, assessment of crop yield, monitoring of soil erosion, mapping of soil moisture, tillage mapping, mapping of the change in land-use (such as the encroachment of urban areas on farmland) and precision farming.

9. Precision farming was a technique that enhanced agricultural productivity on farms of large acreage through selective application during optimal periods of crop input in zones. Zones were delimited with the aid of remote sensing, global navigation systems and GIS. In the United States, it was estimated that the number of family-owned farms had decreased from 8 million to 4 million over the last decade as a result of increased costs of farming and decreasing commodity prices. Precision farming would allow farmers to increase yield in a more environmentally conscious manner and to maximize profits through the better use of fertilizers, herbicides, pesticides and water. Planned hyper-spectral satellite constellations such as the Geophysical and Environmental Research Corporation (GER) Earth Resources Observation System (known as GEROS) would provide precision farmers with high-resolution image products (such as maps showing weed distribution and hailstorm damage) on a regular and timely basis.

10. Parallel to the development of new satellite systems for remote sensing, there are current initiatives to improve civilian access to the geo-positioning data available from global navigation satellite systems. The European Geostationary Navigation Overlay Service (EGNOS) currently being developed in Europe, which would consist of both space and ground components, would augment the information obtainable from the two existing satellite constellations (the Global Positioning System (GPS) of the United States and the Global Navigation Satellite System (GLONASS) of the Russian Federation). The European Community also planned to develop a new constellation of global navigation satellites with enhanced performances. The new constellation, Galileo, was intended to operate in conjunction with other global navigation systems.

B. Disaster management

11. Natural disasters such as tropical cyclones, typhoons and accompanying storm surges, droughts, forest fires, earthquakes and volcanic eruptions occurred frequently in Asia and the Pacific. It was estimated that more than half of the world's natural disasters occurred in the region. Effects of natural disasters were especially damaging to the agricultural development of countries within the region owing to the fragility of ecosystems, underdeveloped communication networks and high population densities. The consequences of natural disasters were often made worse by environmental degradation caused by human activities and poverty. While the occurrence of natural disasters was beyond human control, the worst effects could be alleviated through the use of early warning systems. Space technology played a crucial role in such systems by facilitating the collection, dissemination, integration and analysis of information during the different stages of

disaster management, namely, disaster preparedness, warning and mitigation. While most attention was given to natural disasters of high intensity and short duration, there were other, longer-term events that could also cause severe hardship and reduce agricultural production, such as changes in soil salinity and soil structure.

12. In Indonesia, data from satellite remote sensing were integrated with other information in a GIS to provide early warning of forest fires and to prepare fire-hazard maps. The remote sensing data were used to monitor climatic data, estimate rainfall and identify dry areas or hot spots (i.e. areas where fires had already started). It was generally acknowledged that while space technology represented a reliable source of information for effectively managing disasters due to unwanted forest fires, the national and regional authorities might not have sufficient resources to respond adequately with appropriate fire suppression efforts.

C. Crop information systems

13. While some agricultural information systems in Asia and the Pacific were still in the developmental stage, systems in other parts of the world had been operational for several years. The Canadian Crop Information System (CIS) had been established with the help of CCRS in 1987. The system used optical imagery from the Advanced Very High Resolution Radiometer (AVHRR) satellites of the National Oceanographic and Atmospheric Administration (NOAA) of the United States to provide crop information on the state of grain crops across the Canadian prairie region. CIS technology had been transferred to at least one other country through a bilateral arrangement and CCRS had also been involved in several international technology-transfer projects involving the use of radar imagery for soil and crop mapping, including rice monitoring in the Guangdong Province of China. India had several national information systems that were directly relevant to agriculture. They included systems for monitoring agricultural drought, managing natural resources, estimating pre-harvest acreage and crop production, as well as for agro-climatic and development planning. India was currently implementing its Agricultural Research Information System (ARIS), which would allow agricultural scientists throughout the country to gain access to information available both nationally and internationally.

D. Education and training

14. Space technology is used by a number of countries within the region to provide education and training in agriculture. The United Nations-affiliated Centre for Space Science and Technology Education for Asia and the Pacific Region, located in India, had been operational since April 1996. In its first three years of existence, 69 trainees had received training in remote sensing and GIS, while 17 had received training in space meteorology. Apart from that regional initiative, India had developed interactive television distance education programmes aimed at rural populations, including farmers and extension workers. The programmes were tailored to the needs of targeted regions and dealt with subjects that were directly or indirectly relevant to sustainable agriculture development, such as watershed management, health care and environmental protection.

E. Topographic maps and mapping of natural resources

15. It was estimated that topographic maps on the scale of 1:50,000 needed for resource planning existed for only two thirds of the globe and that the average age of such maps was approximately 50 years. Current aerial mapping technology could fulfil existing demand for them in a cost-effective manner. Reliance must therefore be placed on new high- resolution optical and radar satellite systems. The radar systems, unlike the optical systems, were not affected by prevailing weather conditions and the data collected could be used to generate topographic maps using recently developed radar interferometric techniques.

16. Satellite radar data had also been used in a cooperative project between ESA and the Ministry of Science and Technology of China to discriminate forest from non-forest zones in Guangdong Province. Data from space-borne sensors had been used for forest mapping, monitoring and biomass estimation in China since the 1980s. In particular, satellite data had been used extensively in the Three Norths forest shelter project in which over $460 million had been spent in efforts to improve the ecological environment and promote economic development. The data were applied to various technical assessments such as the survival rate of afforestation, the extent of rebuilt pasture area, the degree of soil improvement and the rate of reduction of desertification.

IV. Summary of panel discussions

17. Two panel discussions were held during the second and third sessions of the Conference (see the annex to the present report for the programme of the Conference). The panels focused on issues of regional interest raised during the formal presentations. A major objective of the panel discussions was to decide upon a limited number of specific actions consistent with the recommendations made at the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in July 1999.[4]

18. The Conference agreed that an acceptable definition of the concept of "sustainable development" in agriculture was one in which the development satisfied the following conditions: (a) that it lead to the production of sufficient food; (b) that it did not harm the environment; (c) that it was acceptable to society; (d) that it was an economically viable approach; and (e) that it met the needs of the present without sacrificing the ability of future generations to meet theirs.

19. The issue of sustainable agricultural development was of paramount importance to countries in Asia and the Pacific region, including China, which had approximately 7 per cent of the world's arable land but whose nationals constituted a disproportionately larger 22 per cent of the world's population. The necessity for nations to be able to feed their growing populations while at the same time being confronted by decreasing availability of arable land was a major reason why countries within the region were increasingly relying on the information that space technology could provide for making decisions related not only to current operational activities but also to long-term planning.

20. The space technologies deemed to be of greatest relevance to sustainable agricultural development in the region were identified as being satellite remote sensing, global navigation satellite systems and GIS. Those three technologies provided information for decision-making in a wide range of agriculture-related areas, including investigation of agricultural land resources, classification of crop types, monitoring crop conditions, forecasting crop yield, assessment of soil erosion, applications for precision agriculture, mapping of forest cover, preparation of agricultural censuses, compilation of land-use statistics, production of maps of natural resources, monitoring of the environment, weather forecasting and disaster management.

21. The Conference agreed that the main constraints to attaining sustainable agricultural development in countries of the region were associated with difficulties in sharing information that related to the application of the technologies mentioned above, especially information about translating results of research studies into operational activities. The Conference noted that two principal benefits that effective sharing of information would allow were (a) the ready retrieval of information on demonstration projects that could raise the awareness of decision makers; and (b) the relative ease for countries in the region to carry out comparisons of operational agricultural methodologies in order to make decisions that would improve the effectiveness of their national programmes.

22. The principal ideas to emerge from the discussions for alleviating the current situation in information sharing were:

(a) Databases on existing or completed projects, associated products and methodologies, as well as databases on national data policies of the countries in Asia and the Pacific should be created;

(b) Since it would be unlikely that all countries would agree to share all their data owing to varying national data policies, copyrights and legal frameworks, countries in Asia and the Pacific needed to develop an agreement specifying exactly what data sets could be shared;

(c) Expert groups focusing on different thematic areas (such as data standards, data policy and data inventory) should be created to study further and develop action plans for the organization and technical implementation of agriculture-related information and data sharing;

(d) Funding from external donors might be needed to support the implementation of information sharing (e.g. training of information specialists) and, in that regard, the use of a logical, structured approach to project formulation would improve the chances of obtaining funding;

(e) Greater emphasis should be placed on human networking for overcoming difficulties;

(f) National capacities needed to be developed further in order to use the technologies of satellite remote sensing, global navigation satellite systems and GIS, as well as to ensure that those technologies were better utilized (e.g. the use of remote sensing in forest fire early warning systems);

(g) Effective natural disaster management in the region required international cooperation covering not only technical but also political and operational aspects;

(h) Efforts should be made to increase the acceptance and utilization of existing information systems that covered national and international regions and that were useful for the management of agriculture disasters within the region (e.g. the Global Resource Information Database (GRID)).

V. Regional issues and associated action plans

23. The Conference identified three priority areas of sustainable agriculture that were of particular interest to the region. It recommended appropriate follow-up action, on the understanding that such action would make full use of the facilities and resources, including those for training, of the Office for Outer Space Affairs and ESCAP, and take advantage of existing expertise, demonstration projects and working groups in the region:

(a) There was a need to exploit more fully the benefits of satellite remote sensing, global navigation satellite systems and GIS for a number of activities critical to achieving sustainable agricultural development, in particular, crop estimation, yield modelling and forecasting. The Office for Outer Space Affairs, in conjunction with ESCAP, should request Member States in the region to identify national coordinators who would be required, among other things:

(i) To identify problems related to agricultural techniques (including crop estimation, yield modelling and forecasting) that hindered sustainable agricultural development;

(ii) To identify the groups at the national level involved in agriculture-related activity and their training needs in the field of space technology, taking into account the training required at different levels of decision-making;

(b) There was a lack of consistency and standardization of agricultural data among countries of the region. In addition, differences in national policies resulted in specialists encountering difficulties in obtaining timely access to data and information. The Office for Outer Space Affairs, in conjunction with ESCAP and other appropriate bodies, should within the limits allowed by their mandates and resources, assist Member States in their efforts to develop an appropriate approach to regional data and information sharing;

(c) Asia and the Pacific was subject to extreme natural events and disasters, which could create great losses both in terms of human life and property and have an adverse effect on the sustainable development of agriculture. Currently, advanced space technologies were not being utilized to their full potential in managing natural disasters. ESCAP should articulate an action plan for regional disaster management, to be circulated to Member States for consideration at the Second Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific, which was to be held in New Delhi from 15 to 20 November 1999.

Notes

[1] See *Report of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 9-21 August 1982* and corrigenda (A/CONF.101/10 and Corr.1 and 2), para. 430.

[2] The full text of several of the presentations made at the Conference are available on the Web site of the Office for Outer Space Affairs at http://www.un.or.at/OOSA/sched/china99progr.htm#Technical Programme

[3] A description of existing and planned remote sensing satellite systems can be found in a background paper (A/CONF.184/BP/3) prepared for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III).

[4] See *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (A/CONF.184/6). See also *Report on the Regional Preparatory Conference for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space for Asia and the Pacific (Kuala Lumpur, Malaysia, 18-22 May 1998)* (A/CONF.184/PC/2) for a general overview of issues of regional interest.

Annex

Programme of the United Nations/China/European Space Agency Conference on Space Applications in Promoting Sustainable Agriculture

Date/time	*Subject*	*Speaker*
Tuesday, 14 September 1999		
8.30-9.30 a.m.	Registration	
9.30-10.15 a.m.	Opening ceremony Chairman: Liu Yanhua (China)	Han Deqian (Vice-Minister for Science and Technology, China) Adigun A. Abiodun (Office for Outer Space Affairs of the United Nations Secretariat) K. Leitner (United Nations Development Programme, China) Giuseppe Giampalmo (European Space Agency)
10.15-10.45 a.m.	Press conference	Adigun A. Abiodun (Office for Outer Space Affairs of the United Nations Secretariat) Zheng Lizhong (National Remote Sensing Centre, China)
	Session I **Agricultural issues and relevant space technologies: benefiting from space technology** Chairman: Tong Qingxi (China) Rapporteur: Guo Lujun (China)	
10.45-11.30 a.m.	Role of remote sensing in achieving national food self-sufficiency and food security	Li Deren (National Remote Sensing Centre, China)
11.30 a.m.-12.15 p.m.	Remote sensing in the information age Chairman: A. Ali (Bangladesh) Co-chairman: Liu Yanhua (China) Rapporteur: Chen Zhongxin (China)	Adigun A. Abiodun (Office for Outer Space Affairs of the United Nations Secretariat)
2-2.45 p.m.	Status and trends in Earth-observation satellite systems	G. Konecny (International Society for Photogrammetry and Remote Sensing)

Date/time	*Subject*	*Speaker*
2.45-3.30 p.m.	Current and potential agricultural applications of micro-satellites	Wei Sun (Surrey Space Centre)
3.45-4.30 p.m	Status and trends in meteorological satellites	Dong Chaohua (World Meteorological Organization)
4.30-5.15 p.m.	Status and trends in satellite navigation and positioning systems	Claudio Mastracci (European Space Affairs)
5.15-6.00 p.m.	ESA-China cooperation	Guy Duchossois (European Space Affairs)

Wednesday, 15 September 1999

Session II

Land-use planning; agriculture crops; fisheries; forestry; rangeland farming

Chairman: S. Karnchanasutham (Thailand)
Co-chairman: Chu Liangcai (China)
Rapporteur: Niu Zheng (China)

9-9.45 a.m.	Land-use planning using remote sensing and GIS techniques	M. Hashim (Malaysia)
9.45-10.30 a.m.	Remote sensing in support of crop management	Heather McNairn (Canada Centre for Remote Sensing)
10.45-11.30 a.m.	Improving soil and crop management at the field level through precision (site-specific) farming	Sheng-Huei Chang (GER Corporation)
11.30 a.m.-12.15 p.m.	Managing the balance between farmland and urban areas using remote sensing	F. Begaud (Spot Image)

Chairman: N. H. Nguyen (Viet Nam)
Co-chairman: Liu Jiyuan (China)
Rapporteur: Chen Youqi (China)

2-2.45 p.m.	The application of remote sensing data for forest monitoring, mapping and inventory	Li Zengyuan (Chinese Academy of Forestry)
2.45-3.30 p.m.	The application of remote sensing and GIS technology in support of rangeland management	Su He (Ministry of Agriculture, China)

Date/time	*Subject*	*Speaker*
3.45-5.30 p.m.	Panel discussion on sessions I and II Moderator: M. Hashim (Malaysia) Rapporteur: Denis Villorente (Philippines)	

Thursday, 16 September 1999

Session III

Management of agricultural disasters and forest fires; information systems and education

Chairman: M. Ganzorig (Mongolia)
Co-chairman: Pan Xizhe (China)
Rapporteur: Chen Zhongxin (China)

9-9.45 a.m.	A review of the major recent agricultural disasters in the Asia-Pacific region	Wu Guoxiang (Economic and Social Commission for Asia and the Pacific)
9.45-10.30 a.m.	Agricultural disaster early warning systems	D.L.B. Jupp (Australia)
10.45-11.30 a.m.	Early warning systems related to forest fires and forest-fire suppression	M. Kartasasmita (Indonesia)
11.30 a.m.-12.15 p.m.	Present status of disaster management of forests and agricultural areas in China	Tang Huajun (Ministry of Agriculture, China)
	Chairman: D.L.B. Jupp (Australia) Co-chairman: Yang Bangjie (China) Rapporteur: Rajiv Mehta (India)	
1.45-2.30 p.m.	Information systems and networks supporting agricultural research and development	V. K. Dhadhwal (India)
2.30-3.15 p.m.	The operational use of space technologies in the provision of education and training in agriculture	J. S. Parihar (India)

Date/time	*Subject*	*Speaker*
3.30-5.00 p.m.	Panel discussion on issues raised during session III Moderator: Rajiv Mehta (India) Rapporteur: Rakhshan Rooli Javed (Pakistan)	
5-6 p.m.	Finalization of the recommendations of the conference: for national and regional action programmes Moderator: Rajiv Mehta (India) Rapporteur: Dewan Abeul Quadir (Bangladesh)	
6-6.30 p.m.	Closing ceremony	

Friday, 17 September 1999

Operational technical and cultural visits

7.30 a.m.-6 p.m.	China Remote Sensing Ground Station, The Great Wall (Juyong Pass) and the Xiyuan Hospital of the Chinese Academy of Traditional Medicine	